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the light decreases in geometrical progression." The length of time for letters and words differs with the size and kind of type (Latin or German), and for words with their length. Letters and words in type of the size of the body of this magazine were read correctly half the time at from 0.001 s. to 0.0017 s. The time for words was in some cases even shorter than for letters. As before, the effect of an immediately following stimulus was to lengthen the time needed for seeing the letter or the word, but if it did not follow within 0.005 s. its effect was reduced. The times needed to see colors and letters represent not only the inertia of the retina, but also that of the brain; at least it may be supposed that stimuli acting on the retina for a less time do produce some effect, which, however, does not reach consciousness.

Some experiments were also made on the grasp of consciousness. Sets of from four to fifteen short perpendicular lines were shown for 0.01 s. Of the eight persons tried, two could give correctly the number seen up to six, two up to five, three up to four, and one not so many. Tried in this way, groups of letters are harder to grasp than groups of figures, because no combination of figures has a wholly strange look. A smaller number of words could be read than single letters; only half as many disconnected as connected words; and only one third as many disconnected letters as letters in words. In these experiments, especially in the last group, the individual differences of the subjects were considerable.

(3) Dr. Cattell's experiments extended only to variations in the intensity of light and induction shocks. Six grades of light were made by putting smoked glass before a Geissler tube, corresponding respectively to 315, 123, 23, 7 and 1 when the full light was counted as 1000. Two grades of higher intensity were made by putting lenses before the tube, but their relative intensity could not be fixed. On the basis of 150 reactions on each, reaction times were found varying for B. from 0.308 s. with the faintest light, to 0.168 s. with the brightest, and for C. from 0.251 s. to 0.128 s.; to these, however, the author does not attach an absolute accuracy, the important point being their relation. The decline took place with every increase of intensity, except once for B. Four grades of electrical stimulation were reacted to in times from 0.182 s. to 0.158 s. for B. and 0.164 s. to 0.131 s. for C., the decline being as before, including the exception of one for B., where perhaps the very violence of the stimulus caused a retardation of the reaction. On continuing the experiments to more complicated processes with grades of light corresponding to 315, 23, and 1, the experimenters found (giving the figures in the order of intensities from the greatest down) as follows:

Perception time, B. 0.049 s., 0.075 s., 0.100 s.; C. 0.085 s., 0.119 s., 0.114 s.

Will time, B. 0.049 s., 0.027 s., 0.020 s.; C. 0.082 s., 0.060 s., 0.078 s.

The Effect of Pure Alcohol on the Reaction Time, with a Description of a New Chronoscope. JOSEPH W. WARREN, M. D. *Journal of Physiology*, Vol. VIII, No. 6.

It must have been disappointing to the experimenter, as it certainly is to the reader, that this fully reported study should have led to such insignificant results. After more than eight thousand reaction-times taken, the conclusions are scarcely more than probabili-

ties, among which these seem to be the best supported, namely, that alcohol favors change of the average reaction time from its normal amount, and that there seems to be no constant and direct connection between the reaction time, either "in quantity or in quality," and the taking of alcohol. These experiments were made before attention had been called to the distinction between what Wundt calls motor and sensory reactions, that is, between those that are automatic and those (distinctly slower) that are accompanied by full psychic processes. The figures found for the normal reactions, from 0.1398 s. to 0.2001 s., would mark them as of the intermediate or mixed class from which uncertain results are apt to follow. The action of the stimulant in inclining the subject toward the motor or sensory form of reaction is not known; it may differ from subject to subject, or even with the same subject at different times. Absolutely irreproachable experiments on reaction-times are not easy to carry out, and certain conditions of experiment perhaps have been too little regarded in these.

The new chronoscope described is an improved form of the Exner Neuræbimeter (Psychodometer of Obersteiner) designed by Prof. H. P. Bowditch. In both instruments the time measurement depends on tuning-fork vibrations; in the earlier one the fork carried the writing point, and a smoked plate was moved beneath it; in the new one the fork carries a smoked card and is drawn backward; the writing point is fixed, except as its movements are controlled by an electro-magnet. A chief advantage of the new instrument is that the subject of experiment can be placed at a distance and out of the range of any disturbing noise from it.

Experiments on Tetanus and the Velocity of the Contraction Wave in Striated Muscle. JOHN P. CAMPBELL. Studies from the Biol. Lab. J. H. U., Vol. IV, No. 3.

The muscles experimented on were the neck retractors of the terrapin, their length and character making them unusually appropriate for such work. The author set himself to determine, first, the least number of stimuli per second required for tetanus, and second, the rate of transit of the wave of contraction. The curarized muscle at 4° C. loaded with about 8 gr. and stimulated by an induction shock once per second, showed tetanus; at 9° five shocks were required, at 21° twenty-five, and at 28° thirty-four. The curarized gastrocnemius of a frog at 25.4° required thirty-seven stimuli per second, ten more than the highest figure before given; a difference due, in the opinion of the author, to the sensitiveness of the apparatus used. The character of the muscle itself is also a factor; its influence is thus generalized: "the more extensible a muscle is, the fewer stimuli per second will suffice to tetanize it." In varying the strength of the stimuli, it was found that those which singly were too slight to produce contraction might result in tetanus if repeated with sufficient rapidity. The rate of propagation was found to be from 2 m. to 2.62 m. per second, with a rapid decline through fatigue (and an increase with increase of load). As regards the direction and rate of stimulation between the electrodes, the experimenter found that, except when very strong, it starts from the cathode and goes toward the anode at a rate much greater than elsewhere in the muscle, as high in fact as 13 m. per second. Some of